EMD和神经网络混合模型的优化研究及应用

摘要：经验模态分解(Empirical Mode Decomposition ,EMD）是一种对非平稳信号进行处理分析的常用工具，目前在许多科学与工程领域得到了广泛的应用。近年来有大量的学者尝试将该技术应用到时间序列的建模与预测中。股票指数数据作为一种典型的时间序列历来受到广大学者的青睐，所以有学者开始将EMD运用到股票指数的预测研究中。然而，在与EMD结合的预测模型中普遍存在两个问题。

首先，EMD算法的核心思想是对信号进行分解，在与预测模型进行混合预测时通常是对各子序列分别建模预测然后对结果求和。所以在对分解信号进行组合预测时，存在模型复杂度高、运算效率低、误差累积等问题。针对该问题，本文改进了常见的基于EMD和ANN的组合模型，从原来单纯的叠加模型EMD-ANN改进为单一预测模型S-EMD-ANN。实验结果表明，改进的模型在预测的精度上有所提高，在模型运算效率上有显著提高。

其次，因为EMD算法的固有特性，在对时间序列进行分解时会引入一定的“前瞻性”偏差，很不幸的是，大多数学者忽略掉了该偏差，使得预测结果表现的相当“漂亮”。针对该问题，本文依据一些学者剔除“前瞻性”偏差的思想改进了基于EMD和ANN的自适应预测模型。实验结果表明，剔除“前瞻性”偏差后，传统自适应混合模型AEMD-ANN和S-AEMD-ANN的预测结果并不优于单独的ANN模型的预测结果。这似乎说明先经过经验模态分解并没有对ANN模型起到改善的作用。所以文中对传统的自适应模型提出了改进，文中提出的改进模型S-AEMD-ANNa的预测结果明显优于传统自适应模型预测结果，而且也优于单独的ANN模型预测结果。这说明文中提出的改进模型即使剔除“前瞻性”偏差也能对ANN模型起到改善作用。

关键词：经验模态分解；股指预测；前瞻性偏差；自适应预测

Optimization and application of hybrid model of EMD and neural network

**Abstract：**Empirical Mode Decomposition (EMD) is a commonly used tool for processing and analyzing non-stationary signals. It has been widely used in many scientific and engineering fields. In recent years, a large number of scholars have tried to apply this technology to the modeling and prediction of time series. Stock index data as a typical time series has always been favored by a large number of scholars, so some scholars have begun to apply EMD to the prediction research of stock indexes. However, there are two problems in the prediction model combined with EMD.

First, the core idea of the EMD algorithm is to decompose the signal. When mixing prediction with the prediction model, it is usually to model and predict each subsequence separately and then sum the results. Therefore, in the combined prediction of the decomposed signals, there are problems such as high model complexity, low computing efficiency, and error accumulation. To solve this problem, this paper improves the common combination model based on EMD and ANN, from the original superimposed model EMD-ANN to a single prediction model S-EMD-ANN. Experimental results show that the improved model has improved the accuracy of prediction, and has significantly improved the efficiency of model operation.

Secondly, because of the inherent characteristics of the EMD algorithm, a certain "Look-ahead" bias will be introduced when decomposing the time series. Unfortunately, most scholars ignore this bias, making the prediction results behave quite "pretty". In view of this problem, this paper improves the adaptive prediction model based on EMD and ANN based on the idea that some scholars have eliminated the "Look-ahead" bias. The experimental results show that after removing the "Look-ahead" bias, the prediction results of the traditional adaptive hybrid models AEMD-ANN and S-AEMD-ANN are not better than those of the separate ANN model. This seems to indicate that empirical mode decomposition has not improved the ANN model. Therefore, the traditional adaptive model is improved in this paper. The improved model S-AEMD-ANNa is significantly better than the traditional adaptive model, and it is also better than the ANN model alone. This shows that the improved model proposed in the paper can improve the ANN model even if the "Look-ahead" bias is eliminated.

**Keywords:** EMD; Stock index forecast; Look-ahead bias; Adaptive forecast